CONTROLLING PATHOGENS IN HEALTHCARE: A WAY FORWARD

Robert A. Weinstein, MD
August 30, 2022
Rush University Medical Center
Cook County Health
Chicago IL

Disclosures: These are my personal views; otherwise, none

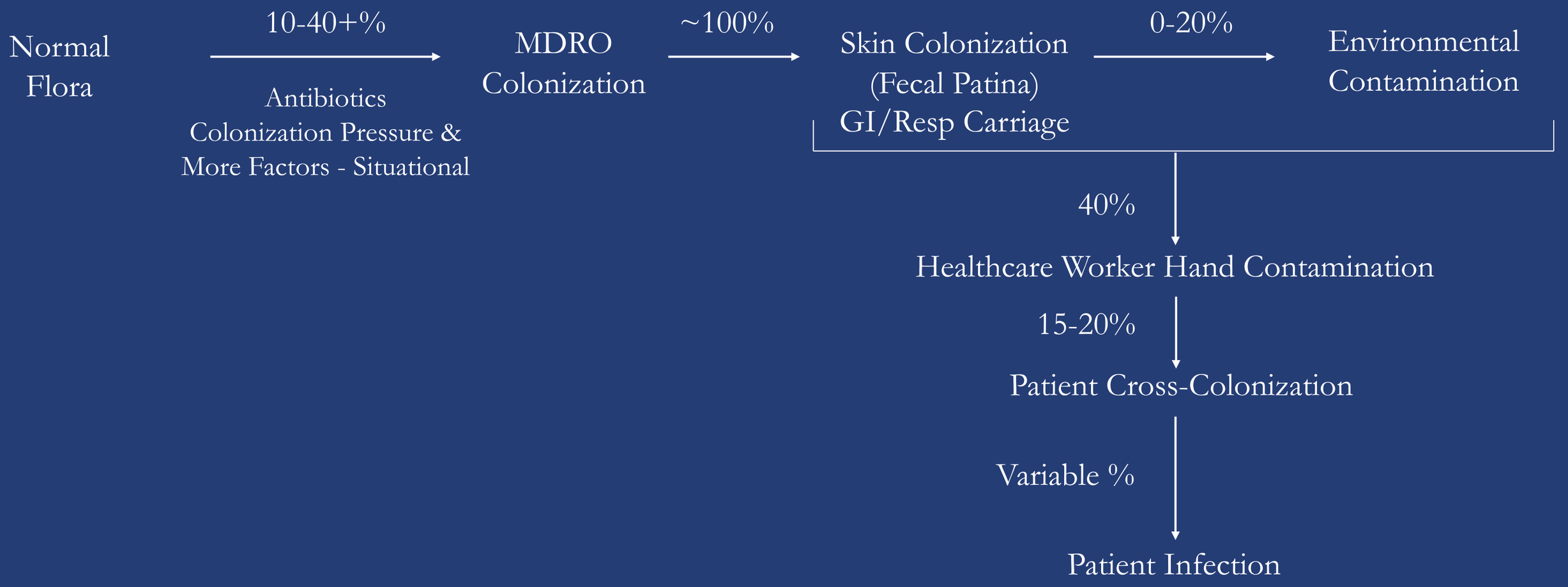
Topics

- Start With A Model of the Causal Pathway of MDRO Spread
- Deconstruct Infection Prevention Ensembles
- Understand the Fecal Patina and Microbiome Inter-Relations

MDRO, Multi-drug resistant organism

Patient Level Infection Control

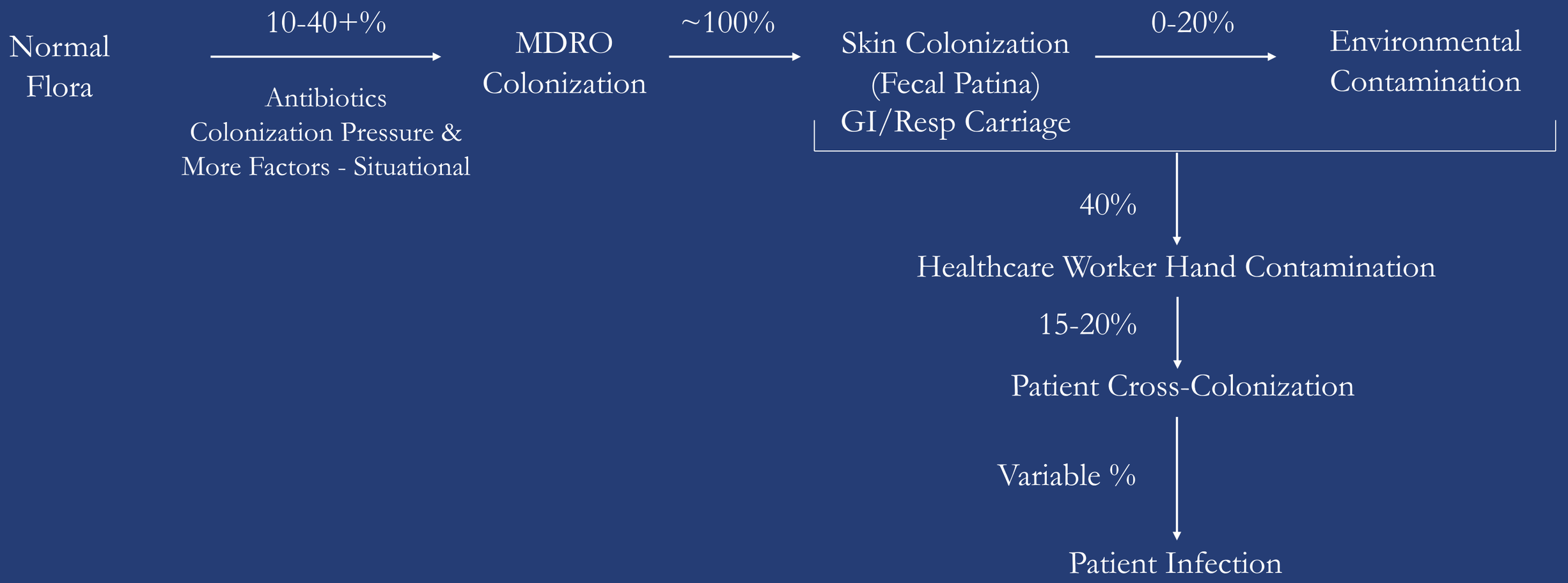
Base Interventions on Causal Pathway of MDRO Spread



MDRO, Multi-drug resistant organism

Patient Level Infection Control

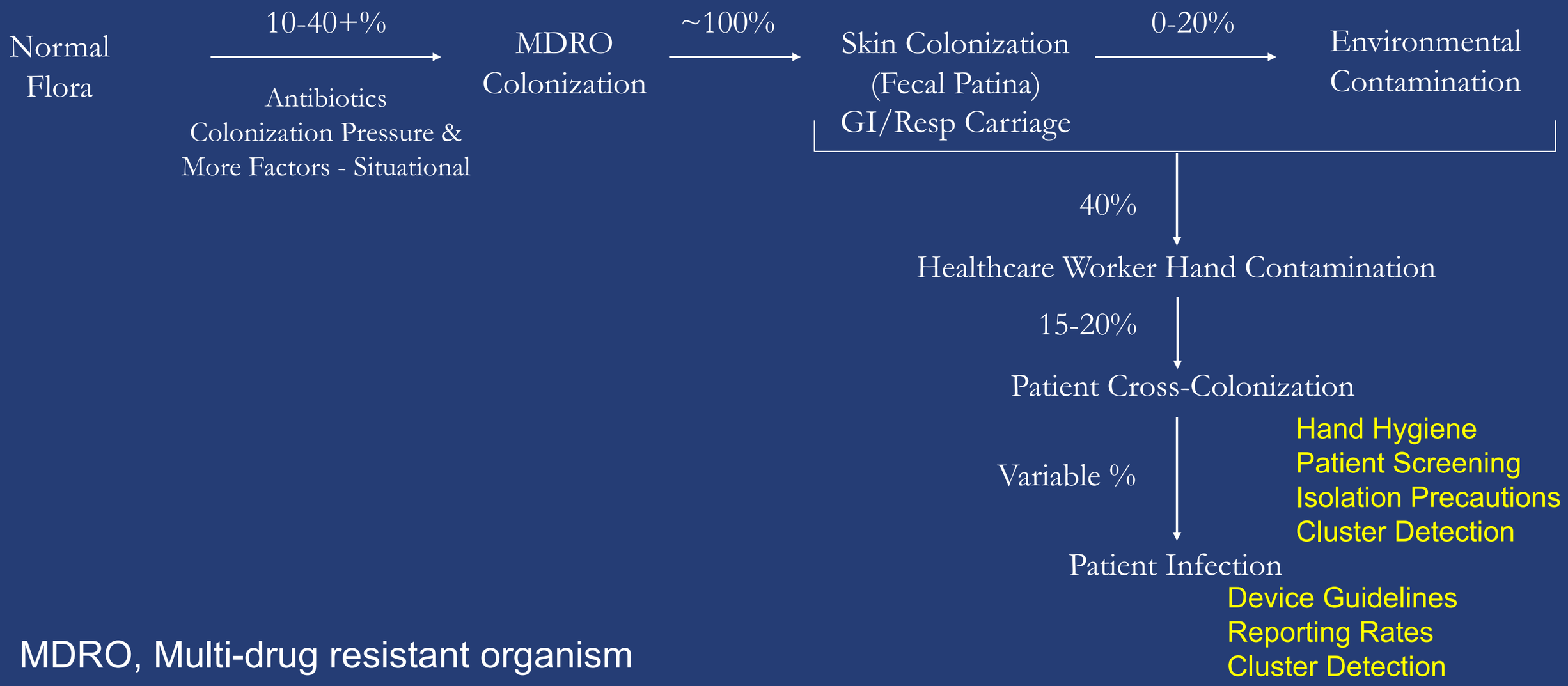
Base Interventions on Causal Pathway of MDRO Spread



MDRO, Multi-drug resistant organism

Patient Level Infection Control

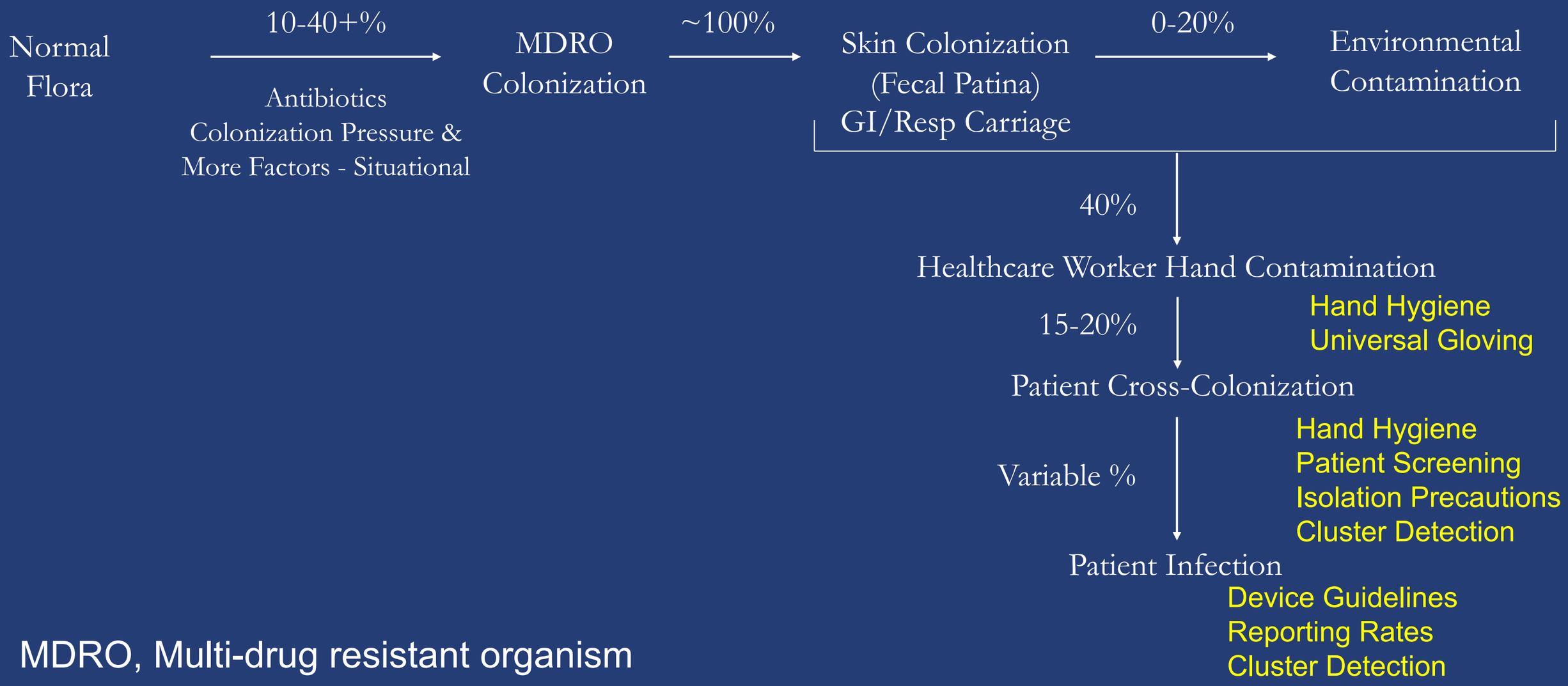
Base Interventions on Causal Pathway of MDRO Spread



MDRO, Multi-drug resistant organism

Patient Level Infection Control

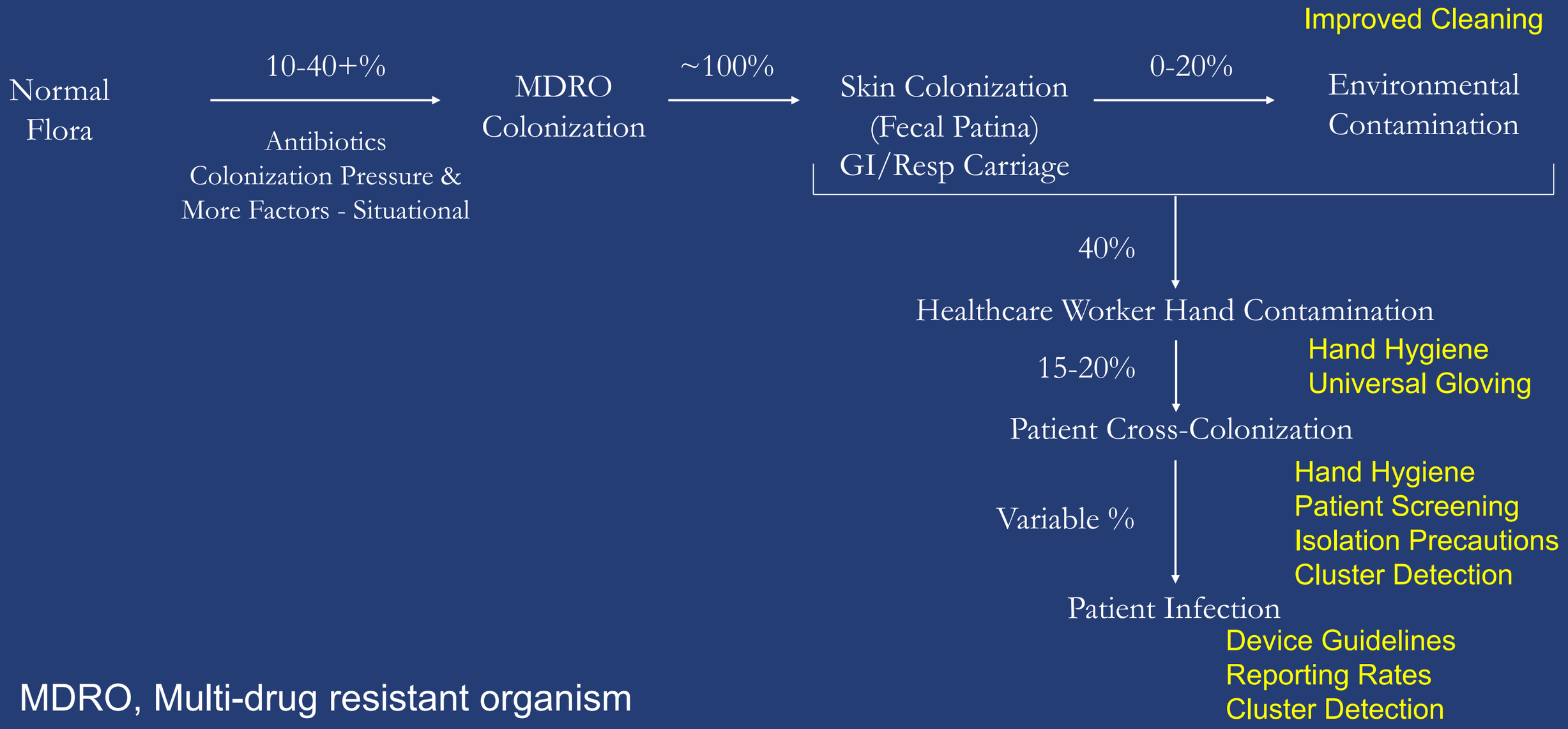
Base Interventions on Causal Pathway of MDRO Spread



MDRO, Multi-drug resistant organism

Patient Level Infection Control

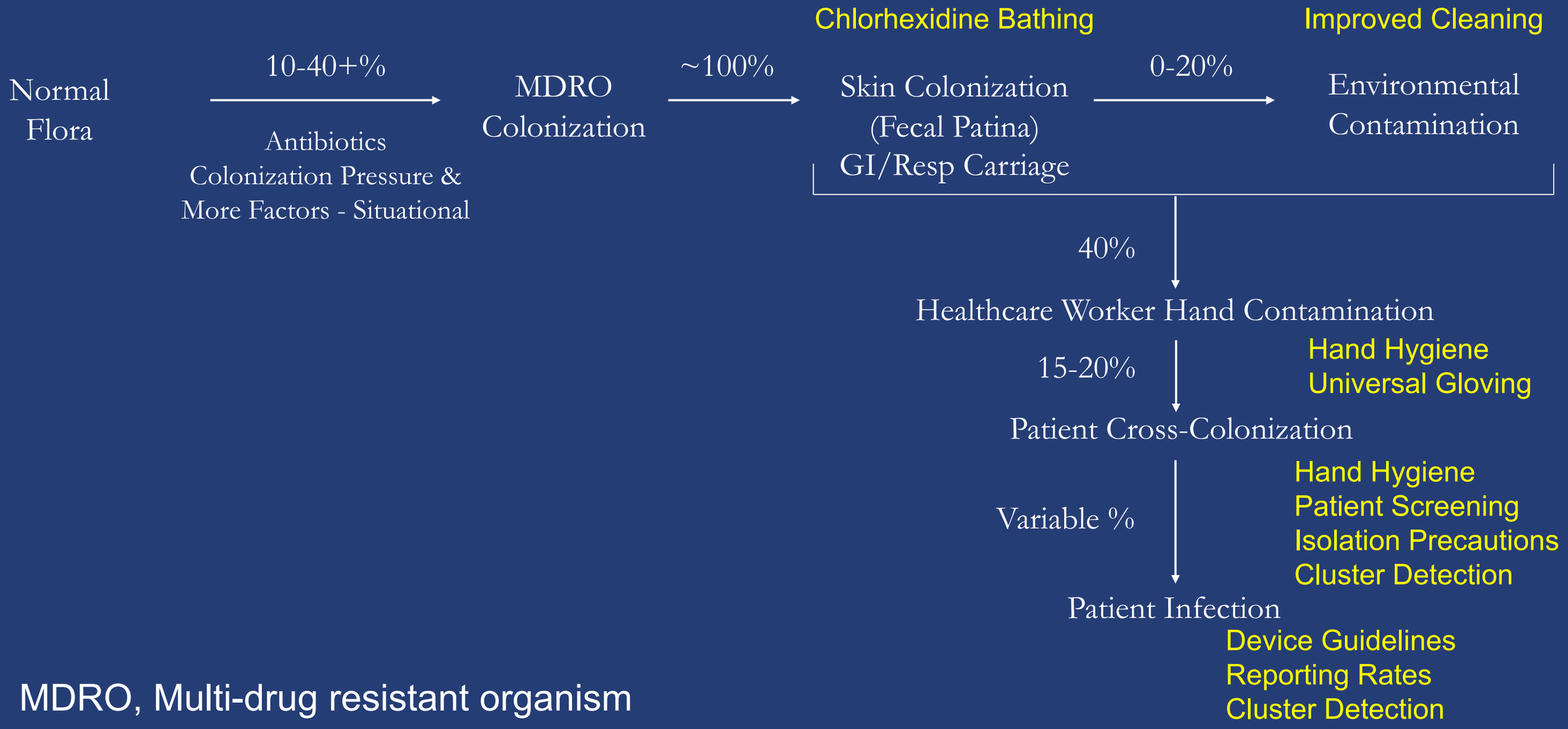
Base Interventions on Causal Pathway of MDRO Spread



MDRO, Multi-drug resistant organism

Patient Level Infection Control

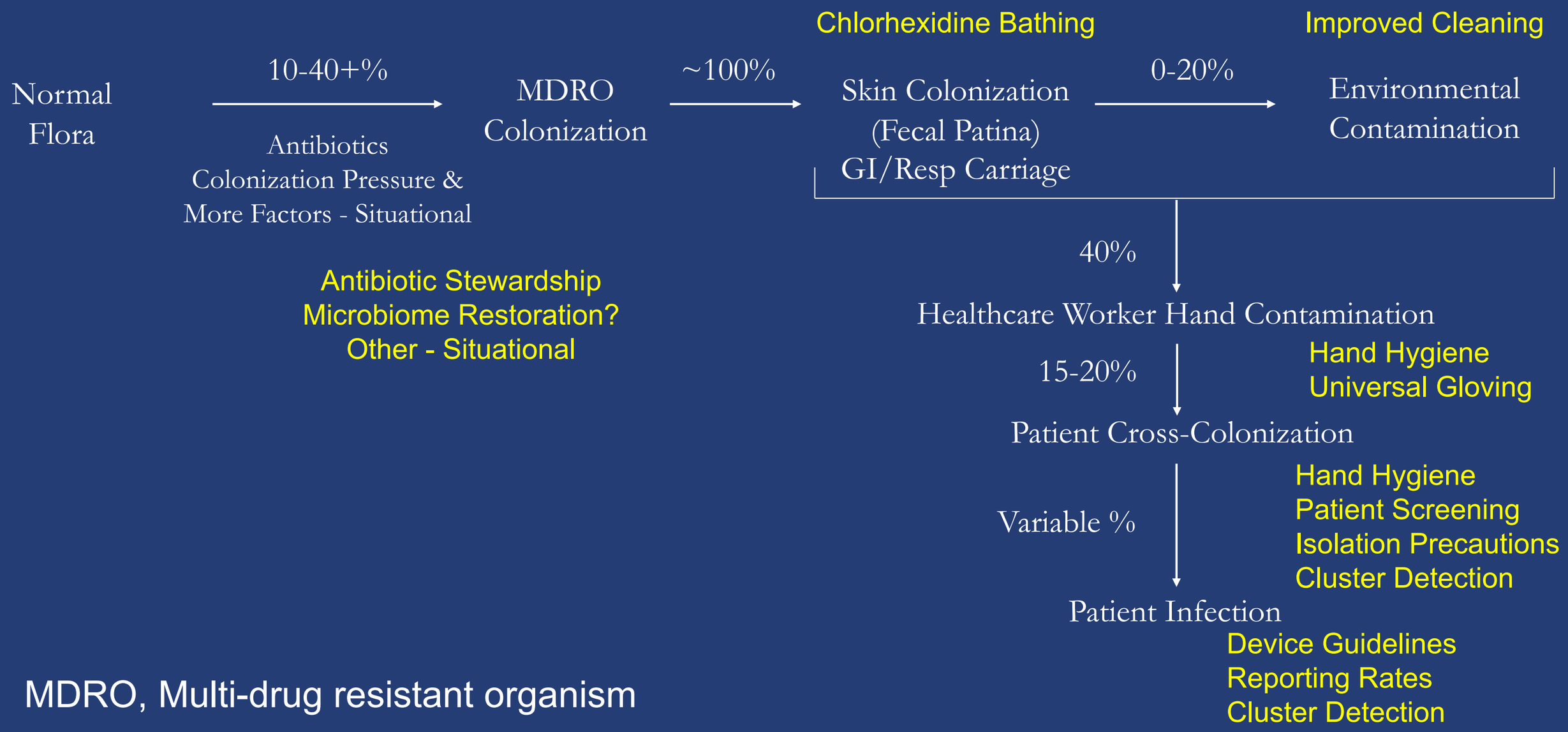
Base Interventions on Causal Pathway of MDRO Spread



MDRO, Multi-drug resistant organism

Patient Level Infection Control

Base Interventions on Causal Pathway of MDRO Spread



MDRO, Multi-drug resistant organism

Ensembles (& Guidelines): Who Does the Heavy Lifting?

CDC/HICPAC IV Catheter Infection Prevention Guidelines
Use this "Bundle" for a "Checklist"

- Education of personnel
- Is catheter needed?
- Avoid routine central line replacement as an infection control Strategy
- Chlorhexidine skin prep (other uses of chlorhexidine?)
- Maximum barrier precautions
- Use of coated catheters (if after full implementation of above, goals are not met)

https://www.cdc.gov/infectioncontrol/pdf/guidelines/bsi-guidelines-H.pdf
HICPAC, Healthcare Infection Control Practices Advisory Committee

“Essential” and other Practices for Preventing CLABSIs

Table 1. Summary of Recommendations to Prevent CLABSI

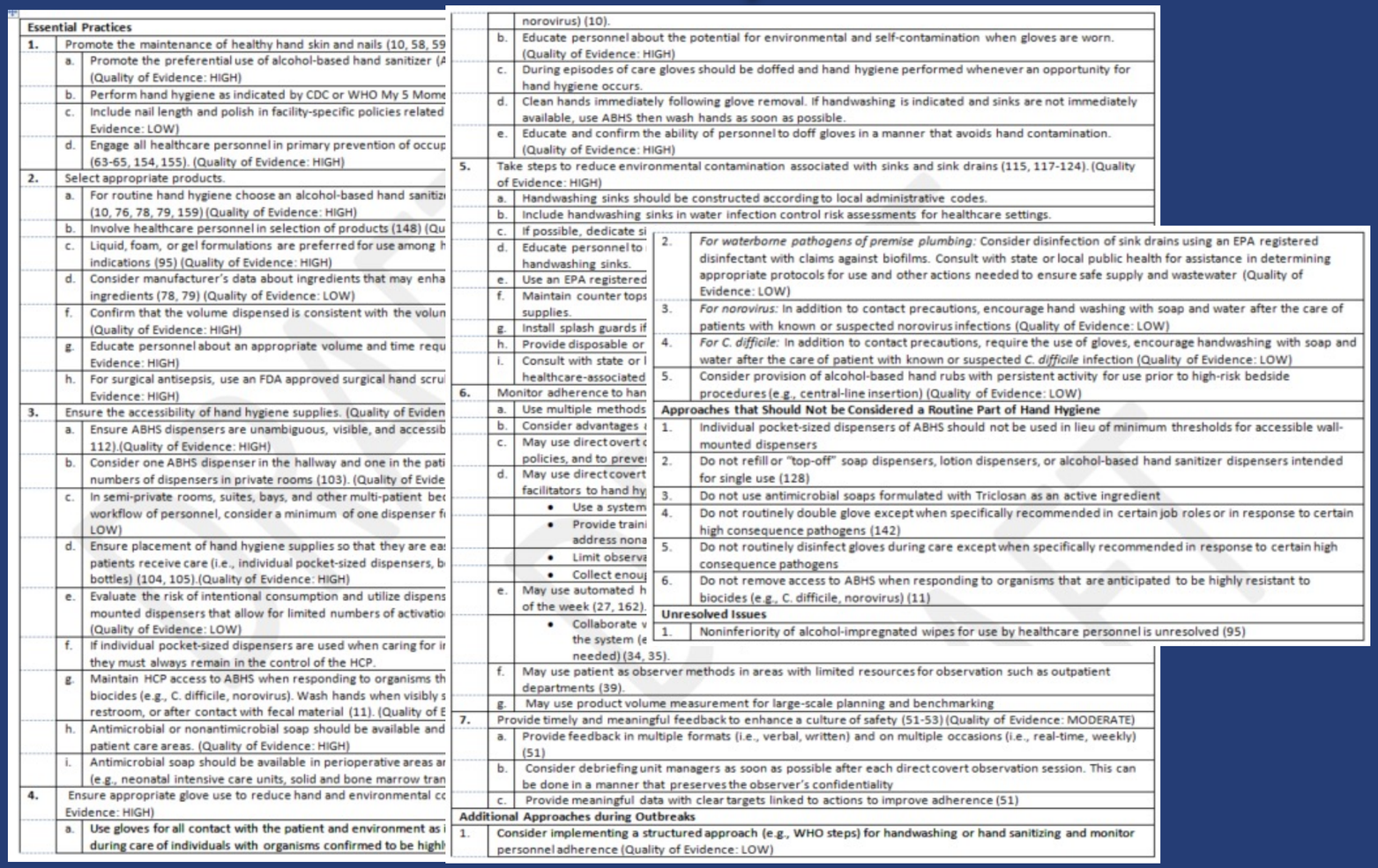
Essential Practices
Before insertion
1. Provide easy access to an evidence-based list of indications for CVC use to minimize unnecessary CVC placement (Quality of Evidence: LOW)
2. Require education and competency assessment of HCP involved in insertion, care, and maintenance of CVCs about CLABSI prevention (Quality of Evidence: MODERATE)[74–78]
3. Bathe ICU patients aged >2 months with a chlorhexidine preparation on a daily basis (Quality of Evidence: HIGH)[86–90]
At insertion
1. In ICU and non-ICU settings, a facility should have a process in place, such as a checklist, to ensure adherence to infection prevention practices at the time of CVC insertion (Quality of Evidence: MODERATE)[101]
2. Perform hand hygiene prior to catheter insertion or manipulation (Quality of Evidence: MODERATE)[102–107]
3. The subclavian site is preferred to reduce infectious complications when the catheter is placed in the ICU setting (Quality of Evidence: HIGH)[33,37,108–110]
4. Use an all-inclusive catheter cart or kit (Quality of Evidence: MODERATE)[118]
5. Use ultrasound guidance for catheter insertion (Quality of Evidence: HIGH)[119,120]
6. Use maximum sterile barrier precautions during CVC insertion (Quality of Evidence: MODERATE)[123–128]
7. Use an alcoholic chlorhexidine antiseptic for skin preparation (Quality of Evidence: HIGH)[42,129–134]
After insertion
1. Ensure appropriate nurse-to-patient ratio and limit use of float nurses in ICUs (Quality of Evidence: HIGH)[34,35]
2. Use chlorhexidine-containing dressings for CVCs in patients over 2 months of age (Quality of Evidence: HIGH)[45,135–142]
3. For non-tunneled CVCs in adults and children, change transparent dressings and perform site care with a chlorhexidine-based antiseptic at least every 7 days or immediately if the dressing is soiled, loose, or damp. Change gauze dressings every 2 days or earlier if the dressing is soiled, loose, or damp (Quality of Evidence: MODERATE)[145–148]
4. Disinfect catheter hubs, needleless connectors, and injection ports before accessing the catheter (Quality of Evidence: MODERATE)[150–154]
5. Remove nonessential catheters (Quality of Evidence: MODERATE)
6. Routine replacement of administration sets not used for blood, blood products, or lipid formulations can be performed at intervals up to 7 days (Quality of Evidence: HIGH)[164]
7. Perform surveillance for CLABSI in ICU and non-ICU settings (Quality of Evidence: HIGH)[13,165,166]
Additional Approaches
1. Use antiseptic- or antimicrobial-impregnated CVCs (Quality of Evidence: HIGH in adult patients[38,39,169–171] and Quality of Evidence: MODERATE in pediatric patients)[172,173]
2. Use antimicrobial lock therapy for long-term CVCs (Quality of Evidence: HIGH)[177–184]
3. Use recombinant tissue plasminogen activating factor (rt-PA) once weekly after hemodialysis in patients undergoing hemodialysis through a CVC (Quality of Evidence: HIGH)[192]
4. Utilize infusion or vascular access teams for reducing CLABSI rates (Quality of Evidence: LOW)[193,194]
5. Use antimicrobial ointments for hemodialysis catheter insertion sites (Quality of Evidence: HIGH)[197–201]
6. Use an antiseptic-containing hub/connector cap/port protector to cover connectors (Quality of Evidence: MODERATE)[202–208]
Approaches that Should Not Be Considered a Routine Part of CLABSI Prevention
1. Do not use antimicrobial prophylaxis for short-term or tunneled catheter insertion or while catheters are *in situ* (Quality of Evidence: HIGH)[209–213]
2. Do not routinely replace CVCs or arterial catheters (Quality of Evidence: HIGH)[214]
Unresolved Issues
1. Routine use of needleless connectors as a CLABSI prevention strategy before an assessment of risks, benefits, and education regarding proper use[215–219]
2. Surveillance of other types of catheters (eg, peripheral arterial or peripheral venous catheters)[11,21,22]
3. Standard, nonantimicrobial transparent dressings and CLABSI risk.
4. The impact of using chlorhexidine-based products on bacterial resistance to chlorhexidine
5. Sutureless securement
6. Impact of silver zeolite-impregnated umbilical catheters in preterm infants (applicable in countries where it is approved for use in children)[227]
7. Necessity of mechanical disinfection of a catheter hub, needleless connector, and injection port before accessing the catheter when antiseptic-containing caps are being used

Note. CLABSI, central line-associated bloodstream infection; CVC, central venous catheter; HCP, healthcare personnel; ICU, intensive care unit.

Buetti N, et al, Infect Control Hosp Epidemiol 2022 https://doi.org/10.1017/ice.2022.87

SHEA/IDSA/APIC Practice Recommendations — Hand Hygiene Practices to Prevent HAIs

DRAFT Update 2022



Essential Practices		
1.	Promote the maintenance of healthy hand skin and nails (10, 58, 59	
	a.	Promote the preferential use of alcohol-based hand sanitizer (A (Quality of Evidence: HIGH)
	b.	Perform hand hygiene as indicated by CDC or WHO My 5 Mome
	c.	Include nail length and polish in facility-specific policies related Evidence: LOW)
	d.	Engage all healthcare personnel in primary prevention of occup (63-65, 154, 155). (Quality of Evidence: HIGH)
2.	Select appropriate products.	
	a.	For routine hand hygiene choose an alcohol-based hand sanitiz (10, 76, 78, 79, 159) (Quality of Evidence: HIGH)
	b.	Involve healthcare personnel in selection of products (148) (Qu
	c.	Liquid, foam, or gel formulations are preferred for use among h indications (95) (Quality of Evidence: HIGH)
	d.	Consider manufacturer's data about ingredients that may enha ingredients (78, 79) (Quality of Evidence: LOW)
	f.	Confirm that the volume dispensed is consistent with the volun (Quality of Evidence: HIGH)
	g.	Educate personnel about an appropriate volume and time requ Evidence: HIGH)
	h.	For surgical antisepsis, use an FDA approved surgical hand scru Evidence: HIGH)
3.	Ensure the accessibility of hand hygiene supplies. (Quality of Eviden	
	a.	Ensure ABHS dispensers are unambiguous, visible, and accessib 112).(Quality of Evidence: HIGH)
	b.	Consider one ABHS dispenser in the hallway and one in the pati numbers of dispensers in private rooms (103). (Quality of Evide
	c.	In semi-private rooms, suites, bays, and other multi-patient bec workflow of personnel, consider a minimum of one dispenser fi LOW)
	d.	Ensure placement of hand hygiene supplies so that they are eas patients receive care (i.e., individual pocket-sized dispensers, b bottles) (104, 105).(Quality of Evidence: HIGH)
	e.	Evaluate the risk of intentional consumption and utilize dispens mounted dispensers that allow for limited numbers of activatio (Quality of Evidence: LOW)
	f.	If individual pocket-sized dispensers are used when caring for i they must always remain in the control of the HCP.
	g.	Maintain HCP access to ABHS when responding to organisms th biocides (e.g., C. difficile, norovirus). Wash hands when visibly s restroom, or after contact with fecal material (11). (Quality of E
	h.	Antimicrobial or nonantimicrobial soap should be available and patient care areas. (Quality of Evidence: HIGH)
	i.	Antimicrobial soap should be available in perioperative areas ar (e.g., neonatal intensive care units, solid and bone marrow tran
4.	Ensure appropriate glove use to reduce hand and environmental cc Evidence: HIGH)	
	a.	Use gloves for all contact with the patient and environment as i during care of individuals with organisms confirmed to be high
		norovirus) (10).
	b.	Educate personnel about the potential for environmental and self-contamination when gloves are worn. (Quality of Evidence: HIGH)
	c.	During episodes of care gloves should be doffed and hand hygiene performed whenever an opportunity for hand hygiene occurs.
	d.	Clean hands immediately following glove removal. If handwashing is indicated and sinks are not immediately available, use ABHS then wash hands as soon as possible.
	e.	Educate and confirm the ability of personnel to doff gloves in a manner that avoids hand contamination. (Quality of Evidence: HIGH)
5.	Take steps to reduce environmental contamination associated with sinks and sink drains (115, 117-124). (Quality of Evidence: HIGH)	
	a.	Handwashing sinks should be constructed according to local administrative codes.
	b.	Include handwashing sinks in water infection control risk assessments for healthcare settings.
	c.	If possible, dedicate si
	d.	Educate personnel to handwashing sinks.
	e.	Use an EPA registered
	f.	Maintain counter tops supplies.
	g.	Install splash guards if
	h.	Provide disposable or
	i.	Consult with state or l healthcare-associated
6.	Monitor adherence to han	
	a.	Use multiple methods
	b.	Consider advantages
	c.	May use direct overt c policies, and to preve
	d.	May use direct covert facilitators to hand hy
		• Use a system
		• Provide traini address nona
		• Limit observa
		• Collect enou
	e.	May use automated h of the week (27, 162).
		• Collaborate v the system (e needed) (34, 35).
	f.	May use patient as observer methods in areas with limited resources for observation such as outpatient departments (39).
	g.	May use product volume measurement for large-scale planning and benchmarking
7.	Provide timely and meaningful feedback to enhance a culture of safety (51-53) (Quality of Evidence: MODERATE)	
	a.	Provide feedback in multiple formats (i.e., verbal, written) and on multiple occasions (i.e., real-time, weekly) (51)
	b.	Consider debriefing unit managers as soon as possible after each direct covert observation session. This can be done in a manner that preserves the observer's confidentiality
	c.	Provide meaningful data with clear targets linked to actions to improve adherence (51)
Additional Approaches during Outbreaks		
1.	Consider implementing a structured approach (e.g., WHO steps) for handwashing or hand sanitizing and monitor personnel adherence (Quality of Evidence: LOW)	

2.	*For waterborne pathogens of premise plumbing:* Consider disinfection of sink drains using an EPA registered disinfectant with claims against biofilms. Consult with state or local public health for assistance in determining appropriate protocols for use and other actions needed to ensure safe supply and wastewater (Quality of Evidence: LOW)
3.	*For norovirus:* In addition to contact precautions, encourage hand washing with soap and water after the care of patients with known or suspected norovirus infections (Quality of Evidence: LOW)
4.	*For C. difficile:* In addition to contact precautions, require the use of gloves, encourage handwashing with soap and water after the care of patient with known or suspected *C. difficile* infection (Quality of Evidence: LOW)
5.	Consider provision of alcohol-based hand rubs with persistent activity for use prior to high-risk bedside procedures (e.g., central-line insertion) (Quality of Evidence: LOW)
Approaches that Should Not be Considered a Routine Part of Hand Hygiene	
1.	Individual pocket-sized dispensers of ABHS should not be used in lieu of minimum thresholds for accessible wall-mounted dispensers
2.	Do not refill or "top-off" soap dispensers, lotion dispensers, or alcohol-based hand sanitizer dispensers intended for single use (128)
3.	Do not use antimicrobial soaps formulated with Triclosan as an active ingredient
4.	Do not routinely double glove except when specifically recommended in certain job roles or in response to certain high consequence pathogens (142)
5.	Do not routinely disinfect gloves during care except when specifically recommended in response to certain high consequence pathogens
6.	Do not remove access to ABHS when responding to organisms that are anticipated to be highly resistant to biocides (e.g., C. difficile, norovirus) (11)
Unresolved Issues	
1.	Noninferiority of alcohol-impregnated wipes for use by healthcare personnel is unresolved (95)

In Progress -- Do Not Distribute

Hand Hygiene and the KISS Principle

Suggested* initial statement at beginning of the *Hand Hygiene Guideline* for the SHEA/IDSA/APIC Practice Recommendations Update:

This is a carefully and thoroughly compiled set of recommendations for use by infection prevention groups that are responsible for developing institutional policies.

For the individual patient provider, the message is simple: Hand hygiene before and after every patient contact is essential.

* From RAW

Microbiomes – Understanding at Clinical, Epidemiologic, & Mechanistic Levels

---

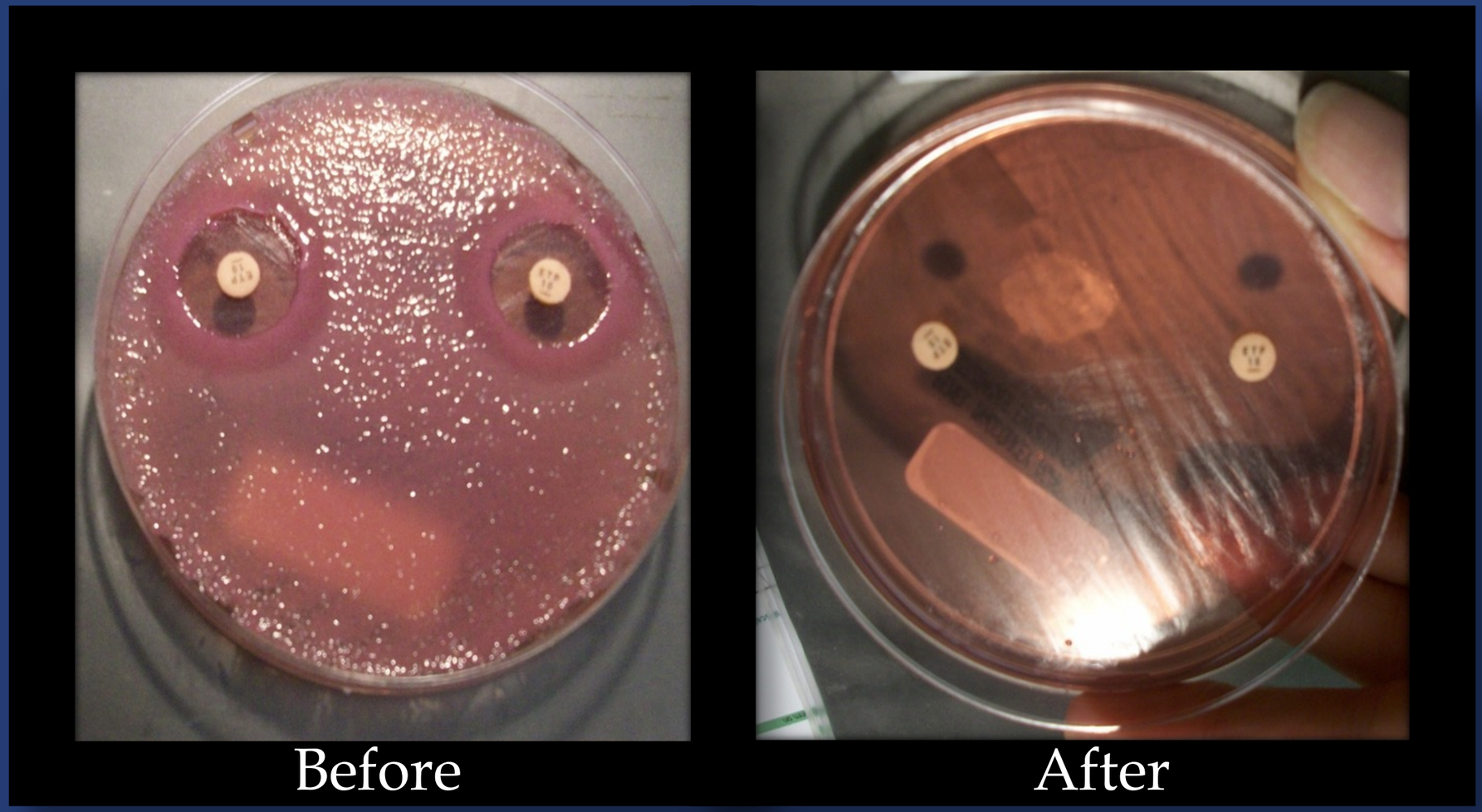
What is hardest of all? That which seems most simple: To see… what is before your eyes.

Goethe

1749 – 1832

Example of The Fecal Patina: Axillary MDROs

Before and After Chlorhexidine Bathing



MDROs, Multi-drug resistant organisms

Example of The Fecal Patina: Axillary MDROs

Before and After Chlorhexidine Bathing

MDROs, Multi-drug resistant organisms

Epidemiologic Factors and MRSA (USA300) Genomic Clusters Among Females at Jail Entrance

Epidemiologic Factor	Included in Genomic Cluster (n = 16), No. (%)	Not Included in Genomic Cluster (n = 28), No. (%)	*P* Value
Site of MRSA colonization			
Nares colonization detected at intake	3 (18.75)	22 (78.57)	<.001
Throat colonization detected at intake	8 (50)	12 (42.86)	.76
Inguinal colonization detected at intake	9 (56.25)	17 (60.71)	1
Exclusive extranasal colonization at intake	13 (81.25)	6 (21.43)	<.001

Genomic cluster defined as MRSA isolates genetically linked by ≤20 single nucleotide variants.

INTERPRETATION

- Nares colonization was negatively associated with being in a genomic cluster and could represent mostly endogenous colonization.
- Exclusive extranasal colonization was associated with being in a genomic cluster, suggesting that this colonization pattern predisposed individuals to exogenous MRSA acquisition.
- Whether absence of nares colonization increases risk for MRSA acquisition in general among at-risk individuals is unclear, but the findings suggest that nasal colonization may serve a controller role in limiting exogenous acquisitions.

Popovich et al, Open Forum Infect Dis 2022 Jan 31; 9(3):ofac049

MRSA, Methicillin-resistant *S aureus*; USA300, WGS type, community-acquired MRSA

CONCLUSIONS

- A model of the "Causal Pathway of Spread of Antimicrobial-resistant Organisms" can help to focus implementation strategies for pathogen reduction in healthcare epidemiology
- Infection control guidelines & bundles are not parsimonious; the relative importance of the individual components should be evaluated
- Studies of microbiomes should assess mechanisms behind the creation of the "fecal patina" and explore the inter-relations of different microbiome components